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# UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	1672-070CON
First Inventor or Application Identifier	David G. Worthy
Title	BIAS COMPENSATING REMOTE AUDIENCE...
Express Mail Label No.	

<b>APPLICATION ELEMENTS</b> See MPEP chapter 600 concerning utility patent application contents.	<b>ADDRESS TO:</b> Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
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- ☒ \* Fee Transmittal Form (e.g., PTO/SB/17)  
 (Submit an original and a duplicate for fee processing)
- ☒ Specification [Total Pages 30]
  - Descriptive title of the Invention
  - Cross References to Related Applications
  - Statement Regarding Fed sponsored R & D
  - Reference to Microfiche Appendix
  - Background of the Invention
  - Brief Summary of the Invention
  - Brief Description of the Drawings (if filed)
  - Detailed Description
  - Claim(s)
  - Abstract of the Disclosure
- ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 5]
- Oath or Declaration [Total Pages 2]
  - ☐ Newly executed (original or copy)
  - ☒ Copy from a prior application (37 C.F.R. § 1.63(d))  
 (for continuation/divisional with Box 16 completed)
    - ☐ DELETION OF INVENTOR(S)  
 Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

- ☐ Microfiche Computer Program (Appendix)
- Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
  - ☐ Computer Readable Copy
  - ☐ Paper Copy (identical to computer copy)
  - ☐ Statement verifying identity of above copies

## ACCOMPANYING APPLICATION PARTS

- ☐ Assignment Papers (cover sheet & document(s))
- ☐ 37 C.F.R. § 3.73(b) Statement of Power of Attorney (when there is an assignee)
- ☐ English Translation Document (if applicable)
- ☒ Information Disclosure Statement (IDS)/PTO-1449 [Copies of IDS Citations]
- ☒ Preliminary Amendment Remarks
- ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
- ☒ \* Small Entity Statement(s) [Statement filed in prior application, Status still proper and desired (PTO/SB/09-12)]
- ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)
- ☒ Other: Return Receipt Postcard; Check for \$345 for filing fee.

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:
- ☒ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: 09, 038,267
- Prior application information: Examiner V. Srivastava Group / Art Unit: 2711

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

## 17. CORRESPONDENCE ADDRESS

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Name (Print/Type)	Lowell W. Gresham	Registration No. (Attorney/Agent)	31,165
Signature	Lowell W. Gresham	Date	20 April 2000

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231.

09/556339

04/24/00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: DAVID G. WORTHY

Serial No.:

Filed:

For: *BIAS COMPENSATING REMOTE AUDIENCE SURVEY SYSTEM AND METHOD*

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**CERTIFICATE OF MAILING**

Assistant Commissioner of Patents  
Washington, D.C. 20231

Dear Sir:

I hereby certify that this correspondence, consisting of this Certificate of Mailing; Continuation Application Transmittal Form; Fee Transmittal (in duplicate); Declaration and Power of Attorney (copy of original as filed); Small Entity Statements (copy of originals as filed); Preliminary Remarks; Patent Application; Five (5) sheets of formal drawings and three (3) copies of same; Updated Information Disclosure Statement w/Form PTO-1449; Check in the amount of \$345 for filing fee; and a Postcard are being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

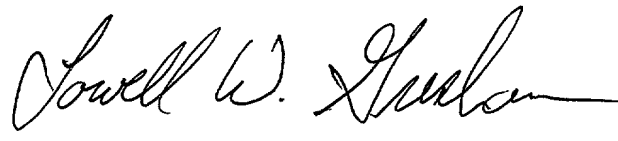
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on

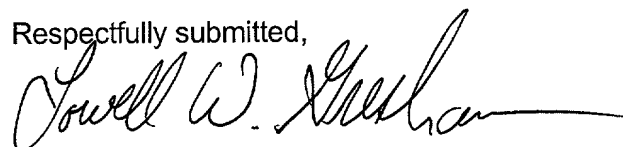
20 April 2000  
Date

20 April 2000

MESCHKOW & GRESHAM, P.L.C.  
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Signature

Respectfully submitted,

  
\_\_\_\_\_  
Lowell W. Gresham  
Attorney for Applicant  
Registration No. 31,165

Applicant or Patentee: David G. Worthy

Serial or Patent No.:

Attorney's

Filed or Issued: Herewith

Docket No.: 1672-070

For: *BIAS COMPENSATING REMOTE AUDIENCE SURVEY SYSTEM AND METHOD*

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY  
STATUS (37 CFR 1.9(f) and 1.27(b))-INDEPENDENT INVENTOR**

As a below-named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled, *BIAS COMPENSATING REMOTE AUDIENCE SURVEY SYSTEM AND METHOD*

described in

☒ X the specification filed herewith  
application serial no. \_\_\_\_\_, filed \_\_\_\_\_  
patent no. \_\_\_\_\_, issued \_\_\_\_\_

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

\_\_\_\_\_ no such person, concern, or organization  
☒ X persons, concerns or organizations listed below\*

\*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

FULL NAME MOBILTRAK, INC.

ADDRESS 3000 Riverchase Galleria, 8th Floor, Birmingham, Alabama 35244  
\_\_\_\_\_ Individual ☒ X Small Business Concern \_\_\_\_\_ Nonprofit Organization

FULL NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_  
\_\_\_\_\_ Individual \_\_\_\_\_ Small Business Concern \_\_\_\_\_ Nonprofit Organization

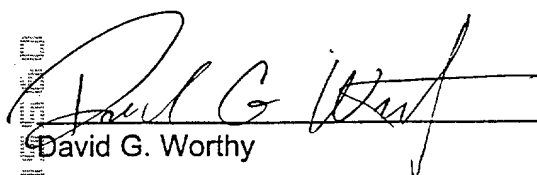
FULL NAME \_\_\_\_\_

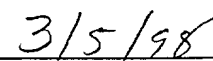
ADDRESS \_\_\_\_\_  
\_\_\_\_\_ Individual \_\_\_\_\_ Small Business Concern \_\_\_\_\_ Nonprofit Organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

SOLE INVENTOR:

  
David G. Worthy

  
Date

In re the Application of: <b>Worthy, D.</b>	Date: <b>20 April 2000</b>
Serial Number: <b>unassigned</b>	Group Art Unit:
Filed: <b>herewith</b>	Examiner:
Title: <b>"Bias Compensating Remote Audience Survey System and Method"</b>	Attorney Docket No: <b>1672-070CON</b>

## PRELIMINARY REMARKS

Assistant Commissioner For Patents  
Washington, D. C. 20231

Sir:

The Accompanying 37 CFR 1.53(b) Application is a continuation of Parent Application: Serial No. 09/038,267, filed 10 March 1998, still pending. The Parent Application (Serial No. 09/038,267) will NOT be abandoned.

In the parent (09/038,267) to the present 37 CFR 1.53(b) Continuation application, an Office Action dated 14 September 1999 rejected claims 1, 5, 11-17, and 21. In addition, claims 2-4, 6-10, and 18-20 were objected to as being dependent upon a rejected base claim and claims 22 and 23 were allowed. Accordingly, claims 1, 5, 11, 13-17, and 21 were canceled and claims 2, 6, 12, and 18 were amended in an Amendment, dated 29 February 2000, in the parent case. Claims 3-4, 7-10, 19-20, and 22-23 remained unchanged as originally filed in the parent case.

A Notice of Allowability responsive to the 29 February 2000 Amendment allowed claims 2-4, 6-10, 12, 18-20, 22, and 23. Presumably, the parent case will issue in the near future.

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PRELIMINARY REMARKS

SERIAL NO: (CONTINUATION OF 09/038,267)

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Claims 2-4, 6-10, 12, 18-20, 22-23 from the parent application have been canceled in this Continuation application. Accordingly, claims 1, 5, 11, 13-17, and 21 from the parent application are renumbered as claims 1-9 in this Continuation application.

Independent claims 1 and 17 were modified in the 37 CFR 1.53(b) Continuation application to include limitations which further distinguish applicant's invention from the systems disclosed in the prior art. To summarize, 14 claims have been canceled, and no new claims have been added.

Independent claim 1 of the 37 CFR 1.53(b) Continuation application, also independent claim 1 in the parent case, has been amended as follows:

1. (Amended) In a remote audience survey system, a method of compensating for a station bias, said survey system being configured to identify radio stations to which tuners are tuned, said tuners having predetermined signals emitted therefrom, and said method comprising the steps of:

measuring durations during which a portion of said predetermined signals are received by said survey system, said portion of said predetermined signals describing one of said radio stations;

combining said durations to form a characteristic detection statistic for said one radio station; and

adjusting a sensitivity level to provide an amplitude threshold for said one radio station in response to said characteristic detection statistic to compensate for said station bias prior to collecting survey data.

Claim 2 of the 37 CFR 1.53(b) Continuation application, which was claim 5 in the parent application, remains unchanged as originally filed in the parent case.

PRELIMINARY REMARKS

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Claim 3 of the 37 CFR 1.53(b) Continuation application, which was claim 11 in the parent application, remains unchanged as originally filed in the parent case.

Claim 4 of the 37 CFR 1.53(b) Continuation application, which was claim 13 in the parent application, has been amended to correct the dependency of claim 4 in response to the renumbering of the claims in the Continuation application. Accordingly, claim 4 depends from claim 3 in the Continuation application.

Claim 5 of the 37 CFR 1.53(b) Continuation application, which was claim 14 in the parent application, remains unchanged as originally filed in the parent case.

Claim 6 of the 37 CFR 1.53(b) Continuation application, which was claim 15 in the parent application, remains unchanged as originally filed in the parent case.

Claim 7 of the 37 CFR 1.53(b) Continuation application, which was claim 16 in the parent application, remains unchanged as originally filed in the parent case.

Independent claim 8 of the 37 CFR 1.53(b) Continuation application, formerly independent claim 17 in the parent case, has been amended as follows:

17. (Amended) A bias compensating remote audience survey system for identifying radio stations to which tuners are tuned, said tuners having predetermined signals emitted therefrom, and said system comprising:

an antenna for establishing a detection zone within which a portion of said predetermined signals are occasionally emitted, said portion of said predetermined signals describing one of said radio stations;

a receiver, coupled to said antenna, for receiving said portion of said predetermined signals;

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PRELIMINARY REMARKS

SERIAL NO: (CONTINUATION OF 09/038,267)

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a timer, coupled to said receiver, for measuring durations over which said portion of said predetermined signals are received;

a compiler, in data communication with said timer, for compiling said durations to form a characteristic detection statistic for said one radio station; and

a bias compensator, coupled between said compiler and said receiver, for adjusting a sensitivity level to provide an amplitude threshold for said one radio station in response to said characteristic detection statistic.

Claim 9 of the 37 CFR 1.53(b) Continuation application, which was claim 21 in the parent application, has been amended to correct the dependency of claim 9 in response to the renumbering of the claims in the Continuation application. Accordingly, claim 9 depends from claim 8 in the Continuation application.

The Office Action in the parent case, dated 14 September 1999, rejected claims 1, 5, 11, 13-17, and 21 under 35 U.S.C. §103(a) as being unpatentable over *Worthy* (U.S. Patent No. 5,410,724) in view of *Wernlund* (U.S. Patent No. 3,434,150). Claims 1, 5, 11, 13-17, and 21 were also rejected over *Worthy* in view of *Wernlund* in the 15 April 1999 Office Action.

*Worthy* teaches of a system for identifying radio stations to which tuners are tuned. The *Worthy* system includes an antenna that projects a detection zone across a portion of a road. A scanning receiver couples to and is controlled by a data logging computer. The computer commands the receiver to look for one FM local oscillator (LO) signal that may be emitted from within the detection zone. If one LO signal is detected, other LO signals that may be detected at the receiver are ignored until the one signal is no longer detectable. An attenuator allows LO signals emitted from the radios in the detection zone at noisy frequencies to have the same likelihood of being detected as LO signals emitted at less noisy frequencies. A compiling computer



accumulates the data logged by the data logging computer into a spread sheet.

*Wernlund* also teaches of a system for identifying radio stations to which tuners are tuned through the detection of local oscillator (LO) signals emitted from the tuners. In particular, *Wernlund* teaches of detecting the weak local oscillator signals in the presence of strong distantly generated radio frequency interference. The *Wernlund* system includes two receiving antennas that project a detection zone (i.e., zone of sensitivity 16) across a roadway. The position and interconnection of the two antennas are chosen to cancel strong distantly generated interference or noise and to enhance the level of the desired station dependent signals relative to the noise. (col. 2, lines 13-25) In other words, the *Wernlund* system is configured to improve the signal-to-noise ratio in order to permit reliable detection of weak local oscillator emissions.

The *Wernlund* antennas are positioned so that the desired signal arrives substantially along a line connecting the antennas. The receiving antennas are closely spaced so that the distance between an interfering transmitting antenna and each of the receiving antennas is great so that the power received at each of the receiving antennas will be substantially the same and the interference will cancel. The outputs from the antennas are fed to a difference detector for combining the outputs in phase opposition and for producing a resultant output in accordance with the differences of the outputs from the antennas. Amplifiers may be connected between the antennas and the difference detector to compensate for any difference in gain, and the signal paths from the antennas may be adjusted to have substantially identical amplitude and phase characteristics. (col. 5, lines 64-74)

PRELIMINARY REMARKS

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In response to Applicant's arguments regarding a first rejection of independent claim 1 in the parent case, the Office Action contends that the features upon which Applicant relies (i.e., adjusting an amplitude threshold over which the LO signals from the two receiving antennas must be) are not recited in Applicant's claim 1. The Office Action further contends that although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims.

Accordingly, independent claim 1 is being amended in the 37 CFR 1.53(b) Continuation application to more distinctly point out that which Applicant believes to be the invention. In particular, claim 1 is being amended to point out the feature of "adjusting a sensitivity level to provide an amplitude threshold for said one radio station...". Likewise, independent claim 8, formerly claim 17 in the parent application, is being amended to point out this feature by reciting "a bias compensator, coupled between said compiler and said receiver, for adjusting a sensitivity level to provide an amplitude threshold for said one radio station...".

Applicant teaches of providing an amplitude threshold over which predetermined signals (such as LO signals) must reach in order for the frequency to be detectable by the survey system. This amplitude threshold is provided by adjusting the sensitivity level (page 16, line 21-24, and page 23, line 18, through page 24, line 23).

*Wernlund* does not teach or suggest of adjusting a sensitivity level to provide an amplitude threshold as recited in Applicant's amended independent claim 1. Rather, *Wernlund* teaches of adjusting the gain of the signals from the two receiving antennas to compensate for any difference in gain between the two received

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PRELIMINARY REMARKS

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signals. Accordingly, Applicant's claimed adjusting a sensitivity level to provide an amplitude threshold is not *Wernlund's* gain adjustment.

The 14 September 1999 Office Action in the parent case discusses new grounds for rejection on page 2 of the Detailed Action by contending that it "would have been obvious to compensate for bias prior to collecting data to ensure that the data collected would have been accurate." However, as further stated on page 5 of the Detailed Action, the Examiner concurs with Applicant's arguments that *Worthy* and *Wernlund* do not disclose claim 1 as amended in the previous 25 June 1999 Amendment. That is, the Examiner indicates that neither *Worthy* nor *Wernlund* disclose compensating for said station bias prior to collecting survey data as amended in the previous Amendment. Accordingly, Applicant respectfully notes that the Office Action contains seemingly contradictory remarks.

Nevertheless, the Examiner is respectfully requested to note that, *Worthy* attempts to mitigate the affects of station bias after collecting survey data by performing a pruning process to remove potentially biasing data records away from the remaining data records (col. 11, line 6 through col. 12, line 42). *Wernlund* neither mitigates the affects of nor compensates for station bias either prior to or after collecting survey data. Thus, a combination of *Worthy* and *Wernlund* could not produce Applicant's claimed "adjusting a sensitivity level to provide an amplitude threshold for said one radio station in response to said characteristic detection statistic to compensate for said station bias prior to collecting survey data" as recited in amended independent claim 1.

For the reasons set forth above, the combined teachings of *Worthy* and *Wernlund* do not render obvious Applicant's invention

PRELIMINARY REMARKS

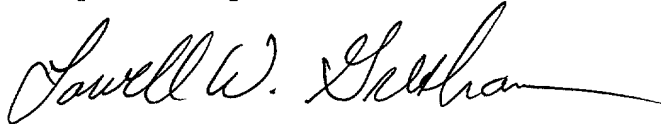
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of claim 1, and independent claim 1 is believed to be allowable. Claims 2-7 (i.e., claims 5, 11, 13-16 in the parent case) depend from claim 1 and are believed to be allowable for the reasons set forth in connection with claim 1. Claims 10 and 11 depend from claim 9 and are believed to be allowable for the reasons set forth in connection with claim 9. Likewise, amended independent claim 8 (claim 17 in the parent case) and claim 9 (claim 21 in the parent case), which depends from claim 8, are believed to be allowable for the reasons set forth above in connection with claim 1.

Applicant believes that the Preliminary Remarks to the accompanying 37 CFR 1.53(b) Continuation application are fully responsive to all rejections mentioned in the 14 September 1999 Office Action in the parent case, and that the present application is now in a condition for allowance. Reconsideration of the above-mentioned rejection is respectfully requested.

Respectfully submitted,



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**BIAS COMPENSATING REMOTE AUDIENCE  
SURVEY SYSTEM AND METHOD**

**TECHNICAL FIELD OF THE INVENTION**

5       The present invention relates generally to identifying  
broadcast stations to which tuners are tuned. More  
specifically, the present invention relates to compensating for  
the effects of bias when identifying, from a remote location,  
the broadcast stations to which tuners are tuned.

**BACKGROUND OF THE INVENTION**

10       The commercial broadcast industry and businesses which  
advertise through the RF broadcast media need to know the sizes  
of the audiences which are tuned to particular stations at  
particular times. This need has been met primarily through the  
15       use of verbal or written audience participation surveys. With  
respect to radio, a majority of the listening occurs in  
automobiles. However, a problem with written surveys is that  
listeners cannot practically make a record of their listening  
tendencies while driving.

20       In order to make a record of listening tendencies while  
driving, passive electronic RF monitoring equipment has been  
used to remotely identify the stations to which tuners may be  
tuned. Generally speaking, audiences' tuners use predetermined  
25       signals, such as local oscillator signals, that are related to  
the frequencies of the respective stations currently being  
tuned in. The local oscillator signals are broadcast or  
otherwise emitted from the tuners as very weak signals that  
sensitive monitoring equipment can detect.

30       This remote monitoring technique is desirable because it  
does not require cooperation from an audience, hence reducing  
or eliminating a host of inaccuracies and costs associated with  
audience participation surveys. Furthermore, large sample

sizes may be monitored at low cost relative to audience participation survey techniques.

Using survey methodology in a remote monitoring system, a highly desirable goal is to maintain a "level playing field", i.e., all stations have an equal opportunity of being recorded during the survey. When a vehicle is detected passing through a survey zone, no bias or preference should occur in detecting the station on the vehicle's radio over another station, regardless of its frequency.

Prior art conventional remote monitoring systems have failed to adequately address many different situations that lead to skewed or biased survey data toward or against an individual station or groups of stations. This bias, described as station bias herein, is different for differing radio stations. For example, multiple tuners located near one another and tuned to the same station may be indistinguishable from one another by the monitoring equipment so as to bias survey data in favor of less popular stations. In addition, conventional monitoring equipment may fail to identify some radio stations due to a weak local oscillator signal at a particular tuner.

The level of background electronic noise may cause local oscillator signals at some frequencies to be more readily detectable than other frequencies leading to station bias in favor of stations whose related local oscillator signals may have a lower level of background noise. In addition, traffic speed, or unexpected variation in traffic speed, affects the duration over which the local oscillator signals may be detected, thus leading to station bias. Still further, the accuracy of the survey data obtained from conventional equipment may be affected by environmental conditions. Temperature and/or humidity fluctuations affect electronic system monitoring and detecting capability differently along

the range of frequencies of local oscillator signals. Hence, local environmental conditions may bias data in favor of some stations and against other stations.

U.S. Patent No. 5,410,724 discusses a remote radio  
5 monitoring system and methodology for obtaining accurate survey data. This system ignores certain detectable and detected data which might otherwise be included in a survey to refrain from introducing unfair biases. This system also attempts to equalize the detection of the noisiest local oscillator signal  
10 with the detection of the other less noisy oscillator signals. Furthermore, this system attempts to prevent station bias caused by environmental fluctuations with the proper selection of electronic components.

However, in the system described in U.S. Patent  
15 No. 5,410,724, as well as the other prior art systems, there was no way of obtaining a measure of the accuracy of the survey data to determine if biases exist toward or against individual frequencies or groups of frequencies within the band of broadcast frequencies for the broadcast stations. Furthermore,  
20 when a station bias does exist for an individual broadcast station, these systems do not compensate for this station bias.

#### **SUMMARY OF THE INVENTION**

Accordingly, it is an advantage of the present invention  
25 that a system and method are provided for compensating for bias when identifying the stations to which tuners are tuned.

Another advantage is that the present invention improves the accuracy of audience survey data.

Another advantage is that the present invention provides a  
30 parameter for determining if biases toward or against individual radio stations or groups of stations are present in survey data.

Yet another advantage is that the present invention notifies an operator when bias is present in survey data.

The above and other advantages of the present invention are carried out in one form in a remote audience survey system, by a method of compensating for a station bias. The survey system is configured to identify radio stations to which tuners are tuned, and the tuners have predetermined signals emitted therefrom. The method includes measuring durations over which the predetermined signals, which describe one of the radio stations, are identified by the survey system. The durations are combined to form a characteristic detection statistic for the one radio station. A sensitivity level is then adjusted for the one radio station in response to the characteristic detection statistic to compensate for the station bias.

The above and other advantages of the present invention are carried out in another form by a bias compensating remote audience survey system for identifying radio stations to which tuners are tuned. The tuners have predetermined signals emitted therefrom, and the predetermined signals describe one of the radio stations. The system includes an antenna for establishing a detection zone within which the predetermined signals are occasionally emitted. A receiver is coupled to the antenna and receives the predetermined signals. A timer is coupled to the receiver and measures durations over which the predetermined signals are received. A compiler is coupled to the timer and compiles the durations to form a characteristic detection statistic for the one radio station. A bias compensator is coupled between the compiler and the receiver and adjusts a sensitivity level in response to the characteristic detection statistic.



**BRIEF DESCRIPTION OF THE DRAWINGS**

A more complete understanding of the present invention may be derived by referring to the detailed description and claims when considered in connection with the Figures, wherein like  
5 reference numbers refer to similar items throughout the Figures, and:

FIG. 1 shows a layout diagram of an example environment within which a preferred embodiment of the present invention may operate;

10 FIG. 2 shows a block diagram of a bias compensating remote audience survey system;

FIG. 3 shows an exemplary graph of the relationship between signal strength and noise quieting values and their respective thresholds for measuring durations of signal detection;

15 FIG. 4 shows a flow chart of an initialization process performed by the bias compensating remote audience survey system;

FIG. 5 shows an exemplary graph that relates local oscillator signals to noise levels determined at each of the  
20 frequencies of the local oscillator signals;

FIG. 6 shows a flow chart of a data logging process performed by a scanning receiver and a data logging computer of the bias compensating remote audience survey system;

FIG. 7 shows a graph of local oscillator signals being  
25 received by the receiver during survey periods;

FIG. 8 shows a flowchart of a bias compensating process performed by a compiling computer and a bias compensator of the bias compensating remote audience survey system; and

FIG. 9 shows an exemplary spreadsheet array of survey data  
30 sorted by radio stations within each of a plurality of survey periods.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

FIG. 1 shows a layout diagram of an example environment within which a preferred embodiment of the present invention may operate. FIG. 1 shows a road 20 on which any number of  
5 radio-equipped vehicles 22, such as cars, trucks, motorcycles, and the like, may travel in either of two directions.

Many of vehicles 22 include a radio or tuner 24 for receiving radio broadcast signals 27 for commercial broadcast stations, such as conventional AM, FM, television, and the  
10 like. For purposes of the following description, radios and tuners are synonymous including all of the components thereof, such as antennas, loudspeakers, and the like. Radios 24 detect radio broadcast signals 27 through a well known demodulation process which requires radios 24 to generate predetermined  
15 signals, such as local oscillator (LO) signals 26 related to radio broadcast signals 27 for radio stations.

The preferred embodiment of the present invention described herein compensates for station bias when identifying FM radio stations to which some of radios 24 may be tuned. However,  
20 those skilled in the art will appreciate that the present invention may be successfully applied to compensating for station bias when identifying AM, L-band, television stations, and so forth, either alone or in combination with the compensation of station bias and the identification of FM  
25 stations. Moreover, the predetermined signals need not be local oscillator signals generated by radios 24, but may be any signal generated or echoed by associated elements of radios 24, including antennas, or loudspeakers, that can be related to radio broadcast signals 27.

30 For the conventional FM band standard used in the United States, each of LO signals 26 oscillate at a frequency around 10.7 MHz above the frequency of the radio broadcast signal 27 for a radio station to which a radio 24 is currently tuned. In

other words, since the FM band for radio broadcast signals 27 is 88.1-107.9 MHz, LO signals 26 are in even tenth-MHz frequencies in the band of 98.8-118.6 MHz. Thus, the frequency of one of radio broadcast signals 27, and ultimately the radio station, to which a radio 24 is tuned can be identified by detecting the presence of the tuner's LO signal 26.

The present invention uses an antenna 28 to establish a detection zone 30 within which LO signals 26 from vehicles 22 may be detected. Detection zone 30 extends across road 20 to cover traffic lanes for two directions. Preferably, antenna 28 is a directional antenna with a substantially flat response through the frequency band of interest (i.e. LO signals 26). The directionality of antenna 28 reduces the likelihood of interference from spurious RF signals emanating from outside detection zone 30.

LO signals 26 are very weak signals which are emitted from radio 24 primarily by a vehicle's antenna 32. The strength of each of LO signals 26 may vary significantly from vehicle 22 to vehicle 22. Those skilled in the art will appreciate that the detection zone 30 depicted in FIG. 1 represents an area in which one of LO signals 26 can be detected, and the duration of detection as vehicle 22 passes through zone 30 can be measured or timed. Detection zone 30 may vary significantly depending in part upon factors such as environmental conditions and electronic noise in and around detection zone 30, sensitivity level settings (discussed below) for each of LO signals 26, and the like.

Temperature and/or humidity fluctuations affect electronic system performance. Electronic components are rated as to their tolerance to such parameters. These fluctuations may affect the detection of LO signals 26 at certain frequencies differently than LO signals 26 at other frequencies which can lead to a station bias for or against certain LO signals 26.

Electronic noise can also vary greatly from area to area, frequency to frequency, and over time during the day and seasonally. In order to detect one of LO signals 26, the signal strength (discussed below) is typically greater than the level of electronic noise at the frequency of interest. Since the frequencies of interest are LO signals 26 in the band of 98.8-118.6 MHz, half of the frequencies are in the upper end of the band for FM radio broadcast signals 27 (which has a relatively high noise level and can vary greatly from frequency to frequency). The other half of the frequencies of LO signals 26 are in the lower half of the aircraft band (above the FM band) where very little noise is present. These differing noise levels can cause station bias at the upper end of the frequency band for FM radio broadcast signals 27 where LO signals 26 may not be detectable over the noise level.

In addition, seasonal changes, such as the presence or absence of leaves on trees, can affect the electronic noise levels at particular frequencies. Leaves on trees can block some electronic noise at particular frequencies to a certain degree during the spring and summer, whereas in winter or fall, when trees lose their leaves, noise levels may increase. These seasonal changes may also produces station bias related to particular frequencies of LO signals 26.

FIG. 2 shows a block diagram of a bias compensating remote audience survey system 34 constructed in accordance with a preferred embodiment of the present invention. System 34 includes antenna 28, discussed above, a scanning receiver 36, a data logging computer 38, a compiling computer 40, and a bias compensator 42. Receiver 36 and data logging computer 38 are preferably located together near antenna 28. In addition, the processing functions of data logging computer 38, compiling computer 40, and bias compensator 42 may be performed by a single unit.

Generally, scanning receiver 36 and data logging computer 38 are configured to receive a portion of LO signals 26 at any frequency in the band of LO frequencies. When one of LO signals 26 is received, receiver 36 produces two outputs (not shown) that are representative of LO signals 26. The two outputs are compared with thresholds for those two outputs, and detection of one of LO signals 26 is made when the produced two outputs exceed the thresholds. Scanning receiver 36 is then configured to receive LO signals 26 at another frequency in the band of LO frequencies, and the detection process is repeated.

Scanning receiver 36 is coupled to antenna 28, and LO signals 26 (FIG. 1) received by antenna 28 are transmitted to scanning receiver 36 for processing. Receiver 36 includes an antenna attenuator (ATTENUATOR) 44, a gain control circuit (GAIN CONTROL) 46, and a detector 48.

Received LO signals 26 are first communicated to attenuator 44. Attenuator 44 serves to equalize the detection of the noisiest ones of LO signals 26 with the detection of the other less noisy ones of LO signals 26 by applying an antenna attenuator value 50 relative to LO signals 26. In other words, greater attenuation is applied to less noisy ones of LO signals 26 to balance the detection of less noisy LO signals 26 with noisier LO signals 26. Each antenna attenuator value 50 is a prescribed value for a specific one of LO signals 26 and may be stored in an attenuator memory element 51 of attenuator 44.

LO signals 26 are communicated from attenuator 44 to an RF conditioner, or gain control circuit 46, where a gain value 52 is applied to LO signals 26. Each gain value 52 is a prescribed value for a specific one of LO signals 26 and may be stored in a gain memory element 53 of gain control circuit 46. The conditioned LO signals 26 are then communicated to an IF detector, or detector 48, where specific ones of LO signals 26 are identified.

In addition to identifying LO signal 26 frequency, detector 48 of receiver 36 produces and evaluates the two outputs, signal strength and noise quieting values (described below), that are representative of LO signals 26. Detector 48 identifies a received one of LO signals 26 by the detection of signal strength and noise quieting values output by receiver 36 that reach signal strength (SS) and noise quieting (NQ) thresholds 54 and 56, respectively, as prescribed for specific LO signals 26. SS and NQ thresholds 54 and 56, respectively, may be stored relative to frequencies for LO signals 26 in a threshold memory element 57 of detector 48. For clarity of illustration, threshold memory element 57 is located in detector 48, however those skilled in the art will recognize that threshold memory element 57 is a memory array that may be stored in memory (not shown) of data logging computer 38.

As is conventional, receiver 36 detects signals that have a magnitude exceeding a sensitivity level (discussed below) for one of LO signals 26. The sensitivity level is adjusted by modifying antenna attenuator value 50, gain value 52, SS threshold 54 and/or NQ threshold 56. Antenna attenuator value 50 and gain value 52 are individually adjustable for each of LO signals 26 in order to equalize the detection of LO signals 26 (i.e. each possible LO frequency). SS threshold 54 is a minimum detectable magnitude of signal strength of LO signals 26 for one of radio broadcast signals 27. NQ threshold 56 is a maximum level of noise quieting that survey system 34 achieves in the presence of LO signals 26 associated with one of radio broadcast signals 27.

FIG. 3 shows an exemplary graph of the relationship between a signal strength value 58 and a noise quieting value 60, and their respective SS and NQ thresholds 54 and 56 for measuring durations 62 of signal detection of one of LO signals 26. Each of LO signal frequencies 26 has a prescribed SS threshold 54

and a NQ threshold 56. For clarity of illustration, signal strength value 58 is shown as an upgoing signal, while noise quieting value 60 is shown as a downgoing signal. However, those skilled in the art will recognize that depending on how the values are mathematically manipulated, signal value 58 and noise quieting value 60 need not be upgoing and downgoing, respectively. When signal strength value 58 for the one of LO signals 26 to which receiver 36 is tuned rises above SS threshold 54 and when noise quieting value 60 drops below NQ threshold 56, LO signal 26 is positively detected. Likewise, when signal strength value 58 drops below SS threshold 54 or when noise quieting value 60 rises above NQ threshold 56, LO signal 26 is no longer detected. Therefore, durations 62 represent lengths of time during which one of LO signals 26 is positively identified. Modifying SS and NQ thresholds 54 and 56, respectively, changes durations 62. Generally, decreasing SS threshold 54 and/or increasing NQ threshold 56 increases each of durations 62, whereas increasing SS threshold 54 and decreasing NQ threshold 56 decreases each of durations 62.

With reference back to FIG. 2, scanning receiver 36 represents a conventional scanner. Hence, those skilled in the art will readily recognize that many other features are included in scanning receiver 36. These may include a central processing unit, a voltage controlled crystal oscillator, additional memory, and so forth (not shown) and will not be discussed in detail herein.

Data logging computer 38 is coupled to scanning receiver 36 via a cable 64 for receiving data associated with LO signals 26 from receiver 36. Generally, data logging computer 38 monitors, controls, records, and reports on system operation and data logging. Data logging computer 38 includes a central processing unit (CPU) 66 which couples to a timer 68. Timer 68 measures durations 62 (FIG. 3) over which LO signals 26 are

received by receiver 36. Data logging computer 38 stores identification of radio broadcast signals 27 identified by LO signals 26 and durations 62 generated by timer 68. Data logging computer 38 represents a conventional microprocessor based computer system. Hence, those skilled in the art will recognize the data logging computer 38 may include additional features such as memory, a disk drive, keyboard, modem, and so forth (not shown) and will not be discussed in detail herein.

Data logged by data logging computer 38 are communicated to compiling computer 40 via a data link 70. Data link 70 may be a link established through a modem and cellular telephone. Alternatively, data link 70 may be provided by physically carrying diskettes from data logging computer 38, or other such linking means.

Compiling computer 40 includes a central processing unit (CPU) 72 which is configured to compile durations 62 as measured by timer 68 to form a characteristic detection statistic 74 for LO signals 26. In the preferred embodiment, the characteristic detection statistic is a station average detection length (ADL) value 74 and is determined by averaging durations 62 for LO signals 26 received at one of the possible LO frequencies.

Durations 62, or the amount of time during which LO signals 26 are positively identified, are controlled by the settings for antenna attenuation value 50, gain value 52, SS threshold 54, and NQ threshold 56. Thus, station ADL value 74 is also affected by the settings for antenna attenuation value 50, gain value 52, SS threshold 54, and NQ threshold 56. By changing any of the above named settings, station ADL value 74 will change and an intentional bias for or against a radio station can be introduced into survey system 34 to compensate for, or mitigate, station bias produced by fluctuating environmental



conditions or changing levels of electronic noise within zone 30 (FIG. 1).

Compiling computer 40 represents a conventional microprocessor based computer system. Hence, those skilled in the art will recognize that compiling computer 40 may include additional features such as memory, a disk drive, keyboard, display, and so forth (not shown) and will not be discussed in detail herein.

Bias compensator 42 is coupled between compiling computer 40 and scanning receiver 36 via links 76 and 78, respectively. Links 76 and 78 are conventional data communication links that may include a cable or radio frequency link provided via a modem and cellular telephone, and will not be described in detail herein.

Bias compensator 42 includes a comparator 80, memory 82, and an alarm 84. Station ADL value 74 compiled by compiling computer 40 is communicated via link 76 to comparator 80. Memory 82 stores a detection parameter 86. In the preferred embodiment, the detection parameter is a multi-station average detection length (ADL) parameter 86 and is formed by averaging durations 62 for all of LO signals 26 of interest. Comparator 80 is configured to compare station ADL value 74 for a specific one of the LO signal channels (i.e. a single broadcast station) to multi-station ADL parameter 86 stored in memory 82. Alarm 84, coupled to comparator 80, issues a notice 88 in response to comparison data (not shown) generated by comparator 80.

Notice 88 may be received by an operator to determine if survey data is valid or if adjustment parameters (not shown) should be sent to scanning receiver 36 to compensate for station bias. The adjustment parameters are sent via link 78 to modify antenna attenuator value 50, gain value 52, SS threshold 54, and/or NQ threshold 56 in order to compensate for

station bias related to one of LO signals 26 representing one of radio broadcast signals 27 (FIG. 1).

Although notice 88 is issued to inform an operator of station bias, nothing in the present invention requires the decision to modify antenna attenuator value 50, gain value 52, SS threshold 54, and/or NQ threshold 56 to be made by a human. Rather, bias compensator 42 may be configured to automatically provide receiver 36 with adjustment parameters to compensate for the station bias.

FIG. 4 shows a flow chart of an initialization process 90 performed by bias compensating remote audience survey system 34. Prior to using system 34 to collect survey data about radio broadcast signals 27, system 34 is initially adapted to achieve a "level playing field", i.e. an unbiased survey of LO signals 26 (FIG. 1).

Process 90 sets initial sensitivity levels for the identification of the radio stations to be surveyed by collecting detection data on road 20 (FIG. 1). This detection data is not relied upon as survey data, but rather is used to adjust antenna attenuator value 50, gain value 52, SS threshold 54 and/or NQ threshold 56 at each individual frequency of LO signals 26 to be surveyed. Process 90 may extend over several days in order to obtain enough data for setting initial sensitivity levels, and may be performed at system start-up or when anomalies in survey data indicate that system reinitialization is desirable. Survey system 34 is placed in an initialization mode, and process 90 begins with a task 92.

To further illustrate the tasks of process 90, FIG. 5 shows an exemplary graph 94 that relates the predetermined signals, or LO signals 26, to noise levels 96 determined at each of LO frequencies 98 for LO signals 26. As discussed previously, LO frequencies 98 are even tenth-MHz frequencies, that are offset

10.7 MHz from station frequencies 100 for radio broadcast signals 27 (FIG. 1).

Those skilled in the art will appreciate that graph 94 illustrates a hypothetical situation, and that the signal amplitude versus frequency picture experienced by system 34 (FIG. 2) will vary from instant to instant and from location to location. Nevertheless, noise levels 96 in the lower half of the frequency range for LO signals 26 are usually significantly higher than noise levels 96 in the upper half of the frequency range for LO signals 26, as illustrated in graph 94.

With reference back to FIG. 4, task 92 causes system 34 to determine a noise level 96 at one of LO frequencies 98 that represents a subset of LO signals 26. In exemplary graph 94 (FIG. 5), a first noise level 102 at a first LO frequency 104 is determined. Determination of noise levels 96 may be made by measuring the amount of electronic noise at one of LO frequencies 98 for a portion of LO signals 26 for a duration of time that is sufficient to capture most of the noise fluctuations occurring over time. Noise levels 96 related to each of LO frequencies 98 is desirably stored in memory (not shown) in compiling computer 40 (FIG. 2).

After task 92 (FIG. 4), process 90 proceeds to a query task 106 which causes system 34 to determine if there is another one of LO signals 26 for which a noise level should be determined. When query task 106 determines that there is a another subset of LO signals 26 (i.e. another LO frequency 98) for which a noise level 96 should be determined, process 90 loops back to task 92 to make another noise level determination. In the exemplary situation shown in graph 94 (FIG. 5), a second noise level 109 (FIG. 5) at a second LO frequency 110 (FIG. 4) relating to a second portion of LO signals 26 (FIG. 1) is determined. In this manner, task 92 is repeated until a noise

level 96 has been determined at each of LO frequencies 98 for each of LO signals 26.

When task 106 determines that there are no other LO signals 26 for which a noise level determination is to be made, process 90 proceeds to a task 112. Task 112 causes compiling computer 40 (FIG. 2) to select one of LO frequencies 98 with the highest of noise levels 96.

In conjunction with task 112, a task 114 identifies the one of LO signals 26 (FIG. 1) with the LO frequency 98 having the highest of noise levels 96 as the noisiest of LO signals 26. In the exemplary situation shown in graph 94 (FIG. 5) first noise level 102 for first LO frequency 104 is greater than noise levels 96 for the remaining ones of LO frequencies 98. Therefore, the one of LO signals 26 that corresponds to first frequency 104 is the noisiest of LO oscillator signals 26.

In response to task 114, a task 116 sets a first initial sensitivity level 118 for the noisiest of LO signals 26. Correspondingly in the exemplary situation of graph 94 (FIG. 5), first initial sensitivity level 118 is set for first LO frequency 104.

First initial sensitivity level 118 provides an amplitude threshold over which first LO frequency 104 must reach in order for first LO frequency 104 to be detectable by survey system 34. First initial sensitivity level 118 is set by modifying antenna attenuator value 50, gain value 52, SS threshold 54, and/or NQ threshold 56 (discussed previously in conjunction with FIG. 2). Modifications may include decreasing antenna attenuator value 50, increasing gain value 52, decreasing SS threshold 54, and/or increasing NQ threshold 56 so that first LO frequency 104 (i.e. the noisiest of LO signals 26) can be more readily detected. By modifying one or more of the above listed parameters, station ADL value 74 (FIG. 2) for the noisiest one of LO signals 26 is established.

Once first initial sensitivity level 118 is set in task 116, process 90 (FIG. 4) proceeds to a task 120. Task 120 initializes a second initial sensitivity level for another one of LO signals 26 at another one of LO frequencies 98.

5 Referring again to graph 94 (FIG. 5), a second initial sensitivity level 122 is set in response to first initial sensitivity level 118. Second initial sensitivity level 122 is set so that station ADL value 74 for second LO frequency 110 is approximately equal to station ADL value for first LO frequency 104. Level 122 is set by modifying antenna attenuation value 10 50 (FIG. 2), gain value 52 (FIG. 2), SS threshold 54, and/or NQ threshold 56 specific to second LO frequency 110. Following task 120, the station ADL value 74 for second LO frequency 110 is established and is approximately the same as station ADL value 74 for first LO frequency 104. 15

Following task 120, a query task 124 determines if there is another one of LO signals 26 at LO frequencies 98 for which an initial sensitivity level is to be set. When there is another one of LO signals 26, process 90 loops back to task 120 to set 20 an initial sensitivity level for another one of LO signals 26. In this manner, task 120 is repeated until sensitivity levels have been determined at each of LO frequencies 98 for each of LO signals 26.

When task 124 determines that there are no other LO signals 25 26 for which a sensitivity level is to be determined, process 90 proceeds to a task 125. Task 125 combines station ADL values 74 for each of frequencies 98 to establish multi-station ADL parameter 86 (FIG. 2) to be stored in memory 82 (FIG. 2).

Although initialization process 90 is a preferred technique 30 for establishing initial sensitivity levels and an initial multi-station ADL parameter 86, there may be other techniques for establishing these parameters in order to achieve a level

playing field (i.e. initialize an unbiased survey system) prior to collection of survey data.

With reference to FIGs. 6-7, FIG. 6 shows a flow chart of a data logging process 126 performed by scanning receiver 36 (FIG. 2) and data logging computer 38 (FIG. 2) of bias compensating remote audience survey system 34 (FIG. 2). FIG. 7 shows a graph 128 of local oscillator signals 26 being received by receiver 36 during survey periods 130. Process 126 is implemented by bias compensating remote audience survey system 34 to provide unbiased identification of radio stations to which radios 24 (FIG. 1) are tuned.

Process 126 begins with a task 132. In task 132, data receiver 36 (FIG. 2) tunes to one of LO signals 26. An array 134 is arranged with LO frequencies 98 for each of LO signals 26 to be included in logging process 126. A pointer 136 is incremented to one of LO frequencies 98 to determine the next LO frequency 98 to which receiver 36 is tuned.

In response to task 132, a query task 138 determines if an LO signal 26 at the one of LO frequencies 98 to which receiver 36 is tuned is being emitted in detection zone 30 (FIG. 1). LO signals 26 are detected when the magnitude for one of LO signals 26 is greater than a sensitivity level specific to the one of LO frequencies 98. When query task 138 determines that LO signal 26 is not present, process 126 loops back to task 132. Task 132 then increments pointer 136 and tunes to another one of LO frequencies 98 for the next stations' LO signals 26.

Referring to exemplary graph 128 (FIG. 7), dashed lines 142 represent tuning episodes 142 for receiver 36. At each of tuning episodes 142, receiver 36 tunes to another one of LO frequencies 98 for LO signals 26. In a first tune period 144, receiver 36 tunes to a first one of LO frequencies 98 for first LO signals 26'. First tune period 144 is a duration of time that elapses between tuning episodes during which receiver 36

is configured to detect one of LO frequencies 98. In addition, first LO signals 26' is that portion of LO signals 26 having the one of LO frequencies 98 to which receiver 36 is tuned. First LO signals 26' at a first LO frequency 98 are detected if the magnitude of the LO frequency 98 for first LO signals 26' is greater than a first sensitivity level 146. When query task 138 determines that LO signal 26 is present, process 126 proceeds with a task 140.

Task 140 measures and records start and stop times for one of LO signals 26 to which receiver 36 is tuned in a data log 148. In addition, task 140 records other parameters, such as signal strength value 58 (FIG. 3) and noise quieting value 60 (FIG. 3) for the one of LO signals 26 in data log 148. Data log 148 is desirably maintained in memory (not shown) of data logging computer 38. Data log 148 is desirably partitioned into survey periods (i.e. first survey period 130' and second survey period 130") for later data processing (discussed below).

In conjunction with task 140, a query task 150 determines if the one of LO signals 26 is gone. LO signals 26 are no longer detected when signal strength value 58 falls below SS threshold 54 or when noise quieting value 60 rises above NQ threshold 56. When query task 150 determines that the one of LO signals 26 is not gone, program control loops back to task 140 to continue logging information into data log 148.

When query task 150 determines that the LO signal 26 is gone, program control loops back to task 132 to tune to another one of LO frequencies 98 to continue to collect survey records. Process 126 is ongoing to provide a continual log of survey data during survey periods 130.

FIG. 8 shows a flowchart of a bias compensating process performed by compiling computer 40 (FIG. 2) and bias compensator 42 (FIG. 2) of bias compensating remote audience

survey system 34 (FIG. 2). Process 152 is implemented to determine a level of validity of the survey results and to compensate for any station bias that might be present.

Bias compensating process 152 begins with a query task 154.

5 Query task 154 determines if the remainder of process 152 should be implemented for one of survey periods 130.

Generally, process 152 is performed at the end of data collection for one of survey periods 130, for example, for a first survey period 130' (FIG. 7). If one of survey periods  
10 130 is not over, survey data is not to be processed yet and program control loops back to query task 154 to wait until the appropriate time for initiating process 152. If survey data is to be processed, program control proceeds to a task 156.

Task 156 causes compiling computer 40 to get data from data  
15 logging computer 38 from the last period. In other words, data records from one of survey periods 130 in data log 148 (FIG. 6) are transmitted via data link 70 (FIG. 2) to compiling computer 40.

Following task 156, a task 158 sorts data to obtain  
20 information regarding the radio stations which were surveyed. FIG. 9 shows an exemplary spreadsheet array 160 of survey data sorted by radio stations 162 within each of a plurality of survey periods 130. Spreadsheet array 160 shows radio stations 162 during survey periods 130. Radio stations 162 are shown  
25 with the associated radio broadcast signals 27 and the related LO signals 26 at LO frequencies 98.

Spreadsheet array 160 may also include a detection number 164 for each of radio stations 162. Detection number 164 indicates how many times one of radio stations 162 was  
30 positively identified during one of survey periods 130.

Spreadsheet array 160 also includes station ADL 74 and multi-station ADL 86 determined for survey periods 130. Those skilled in the art will recognize that other related



information may be included in spreadsheet array 160. For example, difference values between station ADL 74 and multi-station ADL 86, percentage difference, and other values that aid a user or computer program in the identification of station bias for radio stations 162 may be included in spreadsheet array 160.

Following sorting task 158, a task 161 finds station ADL value 74 for one of radio stations 162. To determine station ADL value 74, start and stop times in data log 148 (FIG. 6) downloaded from data logging computer 38 (FIG. 2) are processed to obtain durations 62 (FIG. 3). Durations 62 are then combined by averaging to produce station ADL value 74 for one of radio stations 162.

Following task 161, a query task 166 determines if there is another one of radio stations 162 for which a station ADL value 74 should be found. If query task 166 is affirmative, program control loops back to task 161 to calculate another station ADL value 74 for another one of radio stations 162.

When query task 166 determines that there is not another one of radio stations 162 for which a station ADL value 74 is needed (in other words station ADL value 74 has been calculated for each of radio stations 162), then process 152 proceeds with a task 168.

Task 168 merges durations 62 from each of the detections of radio stations 162 in one of survey periods 130 to obtain multi-station ADL parameter 86 for the one survey period 130. Multi-station ADL parameter 86 is calculated by averaging durations 62. Referring momentarily to FIG. 9, a multi-station ADL parameter 86' is established for a first survey period 130'. Multi-station ADL parameter 86' replaces a previously stored multi-station ADL parameter 86 in memory 82 (FIG. 2) of bias compensator 42 (FIG. 2). It should be noted that numbers indicated for ADL values 74 and multi-station ADL parameter 86'

in spreadsheet array 160 represent a hypothetical situation for clarity of illustration.

Following task 168, a task 170 is performed. Task 170 is performed by comparator 80 (FIG. 2) to compare a station ADL value 74 for one of radio stations 162 to multi-station ADL parameter 86 from one of survey periods 130.

In conjunction with task 170, a query task 172 determines if a level of bias compensation of survey data for one of radio stations 162 is valid. To determine validity of the survey data, station ADL value 74 for the one of radio stations 162 is compared to multi-station ADL parameter 86 for the same one of survey periods 130. When comparator 80 (FIG. 2) of bias compensator 42 (FIG. 2) finds that station ADL value 74 is approximately equal to multi-station ADL parameter 86, the survey data for the one of radio stations 162 is determined to be valid. In other words, the intentional bias introduced into survey system 34, for or against the one of radio stations 162, is adequate to compensate for station bias produced by environmental conditions and electronic noise in detection zone 30 (FIG. 1). Following an affirmative response to task 172, program control proceeds to a query task 174 (discussed below).

In query task 172, when comparator 80 finds that a level of bias compensation may not be valid, in other words, station ADL value 74 is not approximately equal to multi-station ADL parameter 86, program control proceeds to a task 176. Thus station bias may be identified when station ADL value 74 does not approximately equal multi-station ADL parameter 86. As shown in exemplary spreadsheet array 160 (FIG. 9), a first station ADL value 74' is not approximately equal to multi-station ADL parameter 86' for a first survey period 130', therefore process 126 proceeds with task 176.

Station ADL value 74 may not equal multi-station ADL parameter 86 when survey system 34 has not adequately

compensated for station bias toward or against one of radio broadcast signals 27 associated with one of LO signals 26. On the other hand, station ADL value 74 may differ from multi-station ADL parameter 86 under other extenuating circumstances such as an event in road 20 (FIG. 1) that alters the normal traffic pattern or a special radio event which causes drivers to tune to a different one of radio stations 162 (FIG. 9) than they would normally listen to.

Task 176 causes alarm 84 (FIG. 2) of bias compensator 72 to issue notice 88 (FIG. 2) to inform an operator of the discrepancy between station ADL value 74 and multi-station ADL parameter 86. Notice 88 may be an audible "beep", a highlighted flag, or another attention grabber on a display or printed report. In the exemplary situation in spreadsheet array 160 (FIG. 9), an operator is informed through notice 88 that first station ADL value 74' is not approximately equal to multi-station ADL parameter 86'.

Following task 176, a query task 178 determines if a sensitivity level for a portion of LO signals 26 corresponding to the one of radio stations 162 should be adjusted. When query task 178 determines that the sensitivity level should not be adjusted, process 152 proceeds to task 174 (discussed below). A negative response to query task 178 indicates that the discrepancy between station ADL value 74 and multi-station ADL parameter 86 is not due to station bias (as previously discussed), therefore the survey data for the one of radio stations 162 is valid. A decision in query task 178 may, but does not necessarily require, human input.

When bias compensator 42 (FIG. 2) determines in query task 178 that the sensitivity level should be adjusted, program control proceeds to a task 180. Task 180 causes comparator 80 (FIG. 2) of bias compensator 142 to send adjustment parameters (not shown) over link 78 (FIG. 2) to receiver 36 (FIG. 2).

In the preferred embodiment, adjustment parameters are automatically calculated by comparator 80 to modify signal strength threshold 54 (FIG. 2) and/or noise quieting threshold 56 (FIG. 2) for one of LO signals 26. Additionally, adjustment parameters may be calculated by comparator 80 to modify antenna attenuator value 50 and/or gain value 52 for one of LO signals 26.

The modifications produced by task 180 result in an adjusted sensitivity level, for example, an adjusted first sensitivity level 146' (FIG. 7) for first LO signals 26' during a future survey period, such as a second survey period 130". In the exemplary situation shown in graph 128 (FIG. 7), first sensitivity level 146' is lower than first sensitivity level 146. A lower first sensitivity level 146' may increase the likelihood of detection of LO signals 26' during second survey period 130". This produces a bias in favor of LO signals 26' in order to offset station bias against LO signals 26' possibly caused by environmental conditions or electronic noise in detection zone 30 (FIG. 1). First sensitivity level 146' should result in a longer station ADL value 74' for LO signals 26' so as to cause first station ADL value 74' for second survey period 130" to more closely equal a multi-station ADL parameter 86" (FIG. 8) for second survey period 130".

When station ADL value 74 is approximately equal to multi-station ADL parameter 86 in the next one of survey periods 130, the adjustments made during the previous one of survey periods 130 have adequately compensated for station bias directed towards or against first radio station 162.

Adjustment parameters for each of LO frequencies 98 (FIG. 9) relating to LO signals 26, are communicated to scanning receiver 36 (FIG. 2) via link 78 (FIG. 2) during a single transmission event (not shown). These adjustment parameters produce modifications to antenna attenuator value 50, gain

value 52, SS threshold 54, and NQ threshold 56 specific to LO signals 26. The transmission event desirably takes place prior to the initiation of the next one of survey periods 130.

Following task 180, or as stated previously, following an affirmative response to query task 172 or a negative response to query task 178, query task 174 is performed. Query task 174 determines if there is another one of radio stations 162 during one of survey periods 130 for which a station ADL value 74 is to be validated. If there is another one of radio stations, process 152 loops back to task 170 to perform processing for another one of radio stations 162.

When task 174 determines that there are no more radio stations 162 that have survey data to be processed, program control loops back to task 154. This process may be repeated approximately every twenty-four hours or as desired to provide compensation for a second station bias during another one of survey period 130 which may be caused by fluctuating environmental conditions or changing levels of electronic noise.

Although process 152 is described as compensating for fluctuating environmental conditions and changing levels of electronic noise, one skilled in the art will recognize that bias compensating process 152 is able to compensate for other unnamed factors that may lead to station bias, since the station bias is identified when station ADL value 74 differs from multi-station ADL parameter 86.

In summary, the present invention provides a system and method for compensating for station bias when identifying the stations to which tuners are tuned. Since station bias is compensated for, the system and method of the present invention improves the accuracy of the audience survey data. Improved accuracy of the survey data is obtained by providing a parameter for determining the bias, toward or against

individual or groups of radio stations, in a given survey period. Furthermore, the present invention notifies an operator when a station bias is present in the survey data.

Although the preferred embodiments of the invention have  
5 been illustrated and described in detail, it will be readily  
apparent to those skilled in the art that various modifications  
may be made therein without departing from the spirit of the  
invention or from the scope of the appended claims. For  
example, the station average detection level values may be  
10 adjusted with parameters other than those described herein.  
Those skilled in the art can distribute the processing  
functions described herein between a receiver, data logging  
computer, compiling computer, and bias compensator differently  
than indicated herein, or can combine functions which are  
15 indicated herein as being performed at different components of  
the system. Furthermore, those skilled in the art will  
appreciate that the present invention will accommodate a wide  
variation in the specific tasks and specific task ordering used  
to accomplish the process described herein.

**CLAIMS**

What is claimed is:

1. In a remote audience survey system, a method of compensating for a station bias, said survey system being configured to identify radio stations to which tuners are tuned, said tuners having predetermined signals emitted therefrom, and said method comprising the steps of:

measuring durations during which a portion of said predetermined signals are received by said survey system, said portion of said predetermined signals describing one of said radio stations;

combining said durations to form a characteristic detection statistic for said one radio station; and

adjusting a sensitivity level to provide an amplitude threshold for said one radio station in response to said characteristic detection statistic to compensate for said station bias prior to collecting survey data.

2. A method as claimed in claim 1 wherein said durations are first durations, said portion of predetermined signals are first predetermined signals, and said measuring step additionally comprises the steps of:

measuring second durations over which second predetermined signals are identified by said survey system, said second predetermined signals describing a second one of said radio stations; and

merging said first and second durations to establish a detection parameter.

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8. A bias compensating remote audience survey system for identifying radio stations to which tuners are tuned, said tuners having predetermined signals emitted therefrom, and said system comprising:

an antenna for establishing a detection zone within which a portion of said predetermined signals are occasionally emitted, said portion of said predetermined signals describing one of said radio stations;

a receiver, coupled to said antenna, for receiving said portion of said predetermined signals;

a timer, coupled to said receiver, for measuring durations over which said portion of said predetermined signals are received;

a compiler, in data communication with said timer, for compiling said durations to form a characteristic detection statistic for said one radio station; and

a bias compensator, coupled between said compiler and said receiver, for adjusting a sensitivity level to provide an amplitude threshold for said one radio station in response to said characteristic detection statistic.

9. A bias compensating remote audience survey system as claimed in claim 8 wherein said bias compensator is configured to provide said receiver with an adjustment parameter for modifying one of a signal strength threshold, a noise quieting threshold, a gain value, and an antenna attenuation value.

**BIAS COMPENSATING REMOTE AUDIENCE  
SURVEY SYSTEM AND METHOD**

**ABSTRACT OF THE DISCLOSURE**

5        A bias compensating remote audience survey system (34) is  
configured to identify radio stations (162) to which tuners  
(24) are tuned. The tuners (24) have predetermined signals  
(26) emitted therefrom. The survey system (34) employs a  
method (152) of compensating for a station bias, or preference,  
10    toward or against one or more of radio stations (162). The  
method (152) includes measuring durations (62) over which the  
predetermined signals (26) are received by the survey system  
(34). The durations (62) are then combined by averaging to  
form a station average detection length (ADL) value (74)  
15    specific to one of the radio stations (162). The station ADL  
value (74) is compared to a multi-station ADL parameter (86).  
A sensitivity level (146) for the one radio stations (162) is  
adjusted in response to the comparison to compensate for  
station bias.

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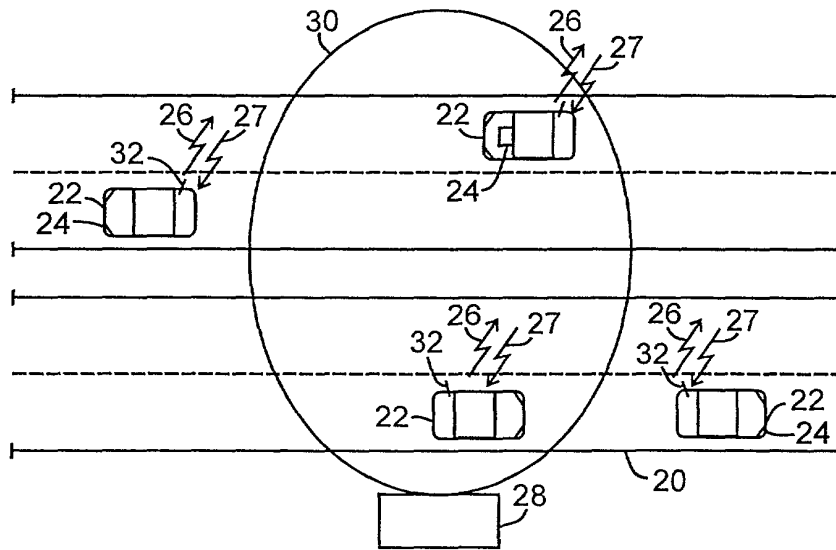


FIG. 1

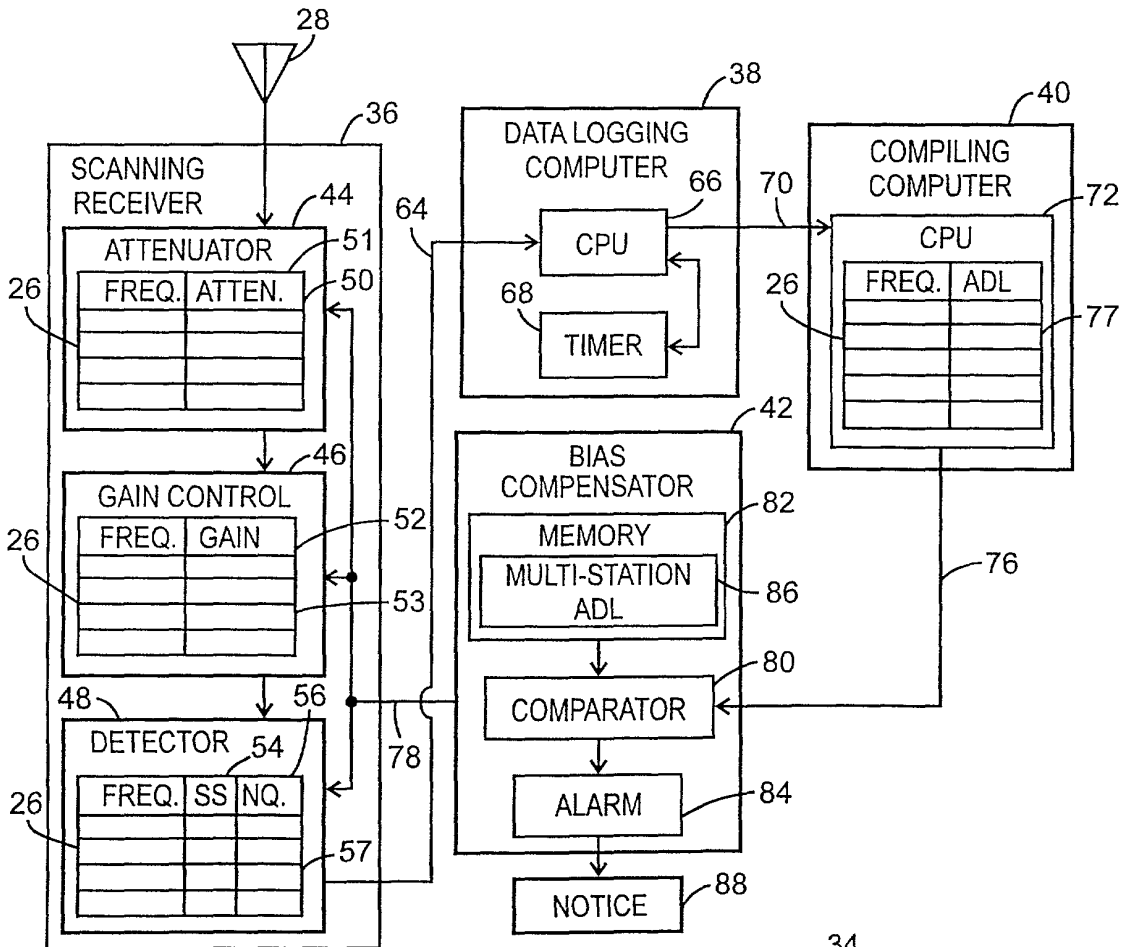


FIG. 2

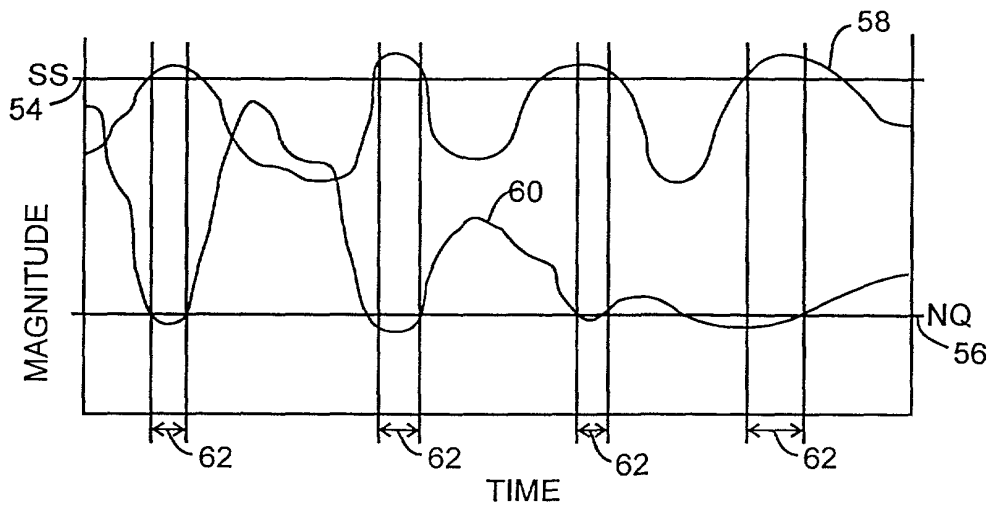


FIG. 3

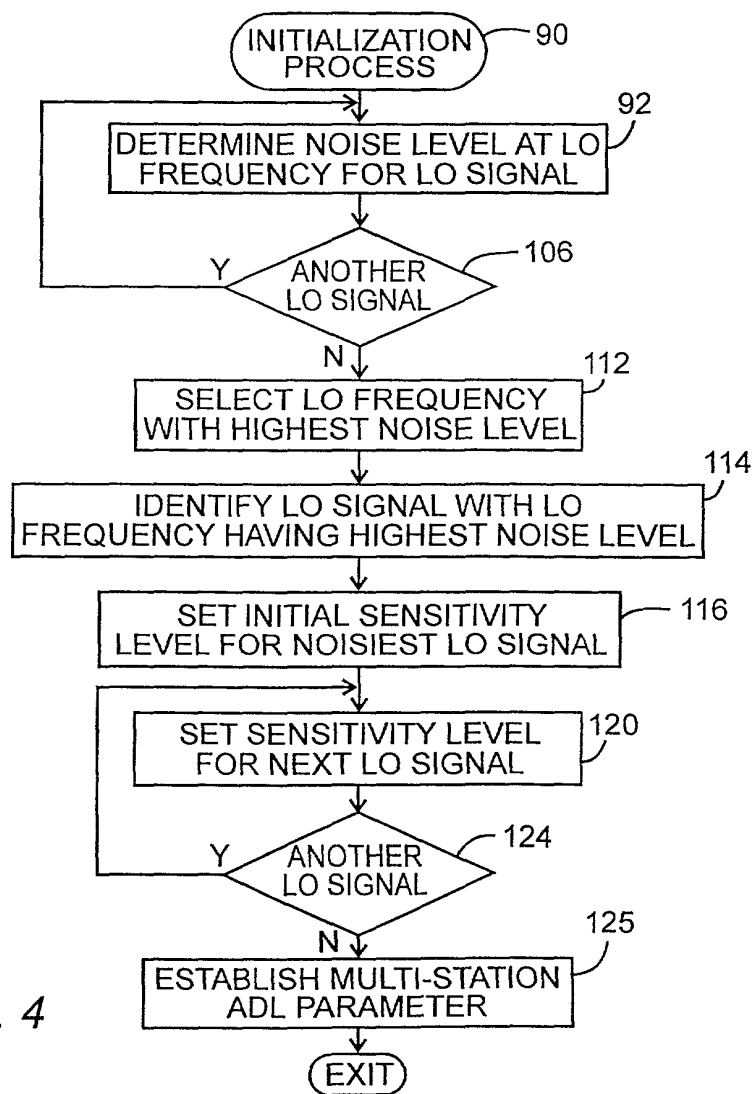


FIG. 4

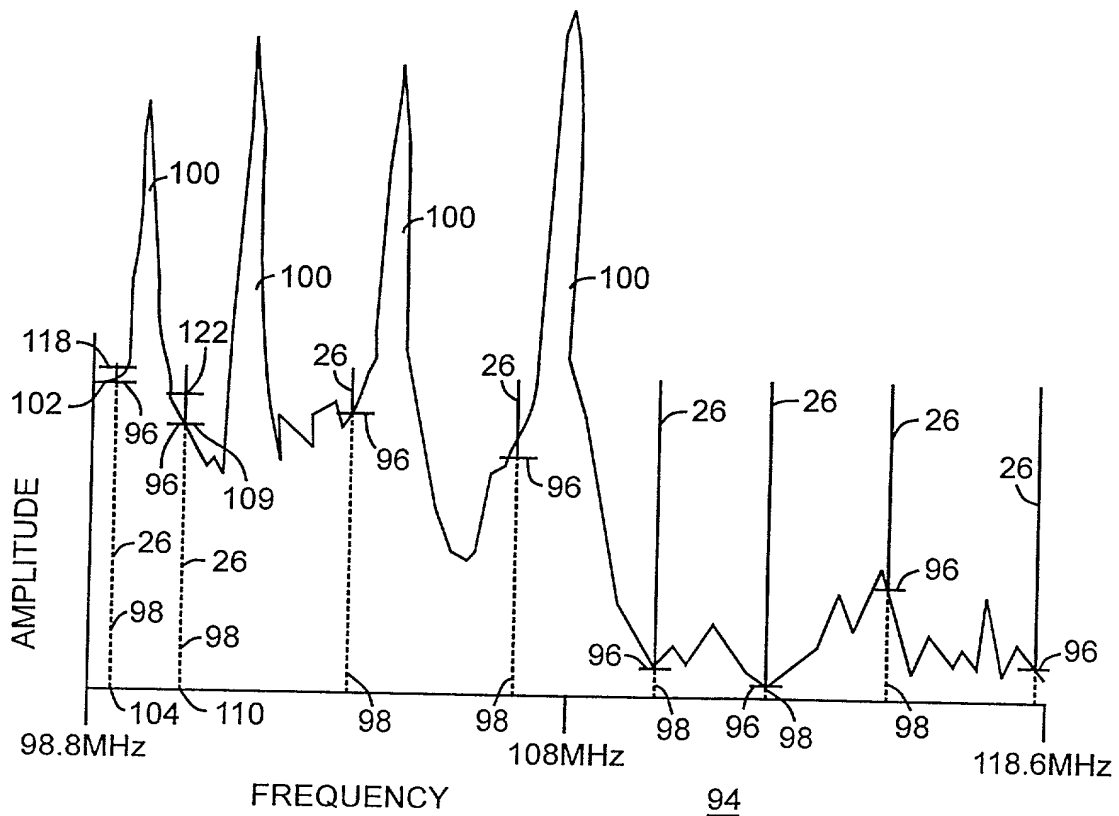


FIG. 5

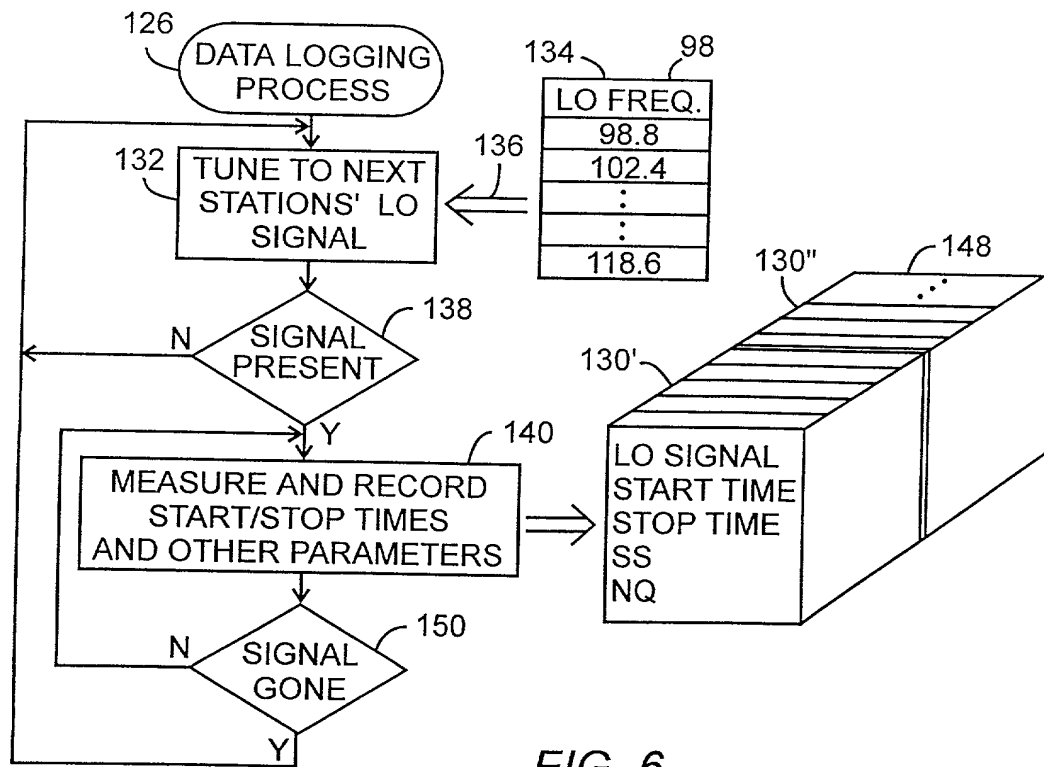


FIG. 6

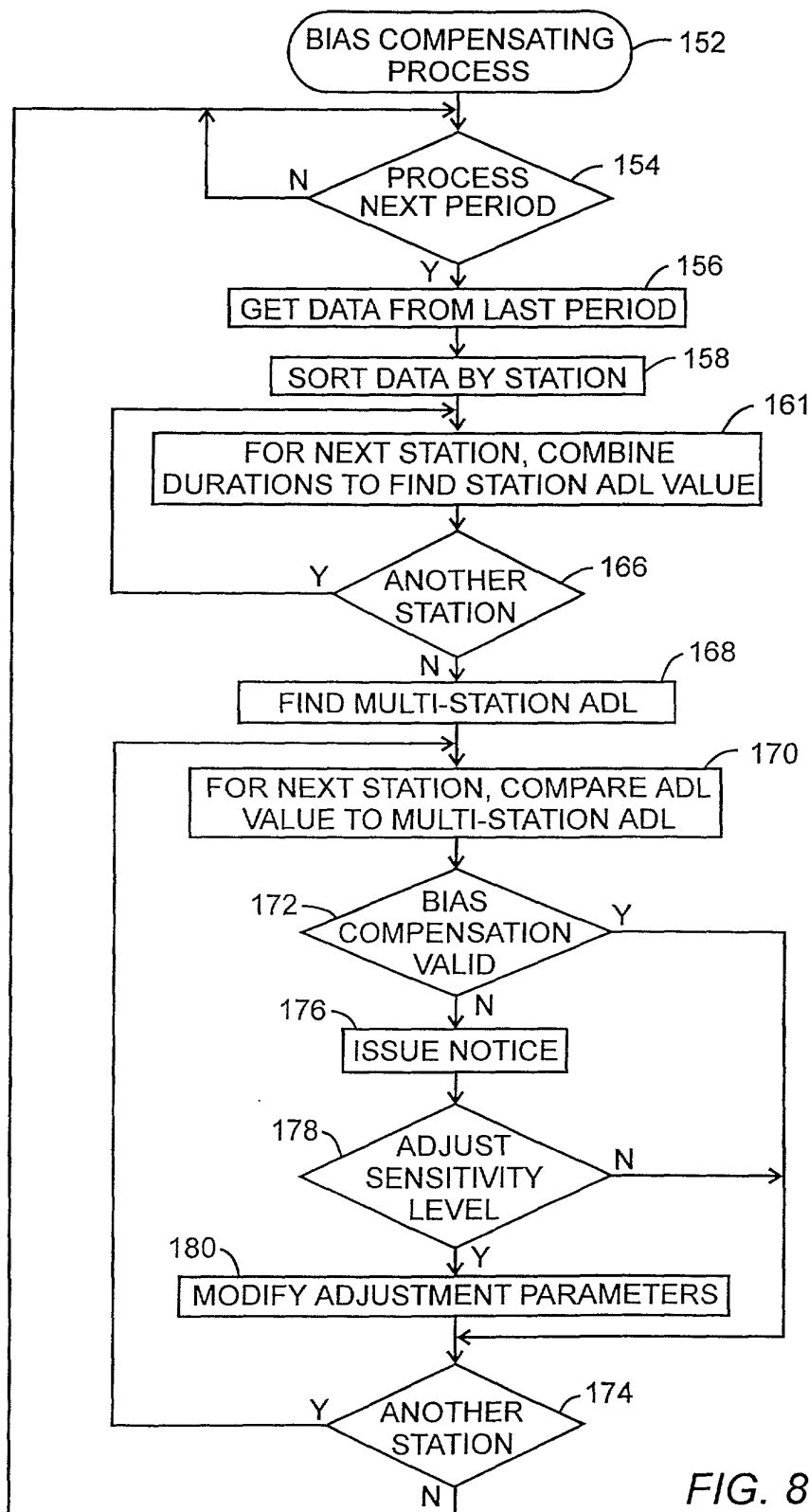


FIG. 8

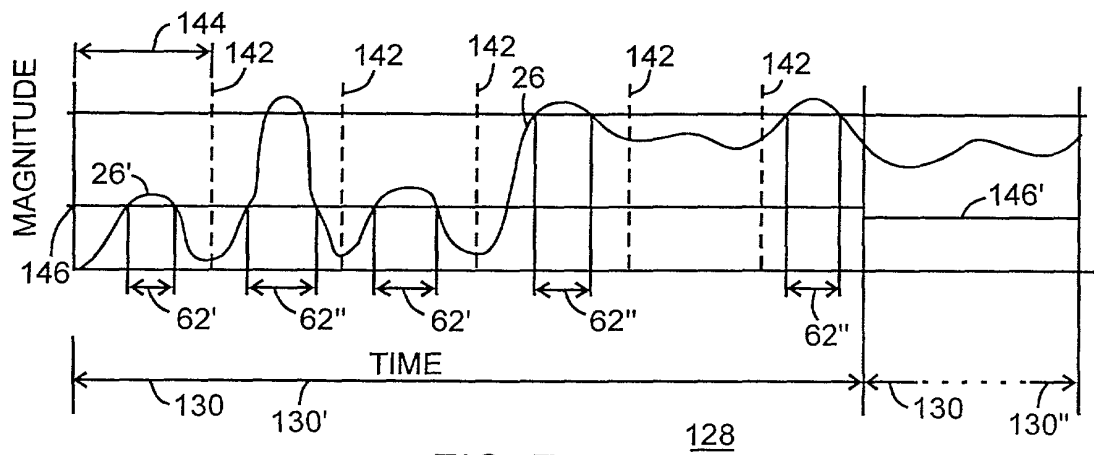


FIG. 7

130	162	27	26	98	164	74	86
SURVEY PERIOD	RADIO STATIONS	RADIO BROADCAST SIGNALS (FREQ.)	LO SIGNALS (FREQ.)	DETECTION #	STATION ADL	MULTI-STATION ADL	
130'	1	88.1 91.7 ⋮ 107.9	98.8 102.4 ⋮ 118.6	XX YY ⋮ ZZ	.33 1.05 ⋮ 1.09	1.0	86'
130''	2	88.1 91.7 ⋮ 107.9	98.8 102.4 ⋮ 118.6		1.02 .99 ⋮	1.0	
	3	88.1 91.7 ⋮ 107.9	98.8 102.4 ⋮ 118.6		⋮	⋮	
	⋮	⋮	⋮	⋮	⋮	⋮	
	n	88.1 91.7 ⋮ 107.9	98.8 102.4 ⋮ 118.6		⋮	⋮	

FIG. 9

Variable	Mean	Standard deviation	Minimum	Maximum
Age	34.5	10.5	20	65
Gender	0.5	0.5	0	1
Marital status	0.5	0.5	0	1
Education	12.5	1.5	10	16
Income	15.5	5.5	10	30
Health status	1.5	0.5	1	2
Life satisfaction	4.5	1.5	1	7
Work satisfaction	3.5	1.5	1	7
Family satisfaction	4.5	1.5	1	7
Community satisfaction	3.5	1.5	1	7
Overall satisfaction	3.5	1.5	1	7

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acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

\_\_\_\_\_  
(Applic. S/N)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status--pend., pat., abandoned)

\_\_\_\_\_  
(Applic. S/N)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status--pend., pat., abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number): Lowell W. Gresham, Reg. No. 31,165  
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Date 3/5/98

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